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*Iowa Geological Survey, Annual Report, 1898, Vol. IX.* By SAMUEL CALVIN, State Geologist; H. F. BAIN, Assistant State Geologist.

*Statistics of Mineral Production.* By S. W. BEYER; *Geology of Carroll County*, H. F. BAIN; *Geology of Humboldt County*, T. H. MCBRIDE; *Geology of Story County*, S. W. BEYER; *Geology of Muscatine County*, J. A. UDDEN; *Geology of Scott County*, W. H. NORTON; *Artesian Wells of the Belle Plaine Area*, H. R. MOSNAT. Thirteen plates, 56 figures, 14 maps.

This volume of the reports of the Iowa State Geological Survey serves to corroborate the high opinion already established among the geologists of the United States of the work of this organization. The record of the Iowa survey has been one of uninterrupted excellence in both the theoretical and the economic phases of its work. The list of the corps engaged in the work of 1898 is of itself sufficient to invite inspection of the report.

Each of the county reports gives a systematic exposition of the physiographic and economic features of the geologic field under consideration, each being emphasized as the peculiar characteristics of the district demand. To many of the reports is appended a discussion of the forestry of the areas studied.

In the geology of Carroll county the physiography is of exceptional interest, since the tract is bisected diagonally by the edge of the Wisconsin drift sheet. Consequently the northeastern and southwestern parts of the county display topographic features in admirable contrast as the result of these relations. The Middle Coon River follows this drift margin in a general way, receiving numerous tributaries with secondary and tertiary branches from the area of Kansan drift westward, while from the Wisconsin drift there is only one important tributary and that without branches. The erasure of post-Kansan drainage by the Wisconsin invasion is illustrated by a number of examples. The Coon River, flowing across the northeast part of the county has constructed a makeshift course from "bits of old captured valleys, and new trenches which it has cut for itself."

The stratigraphy of Carroll county includes an exposure of a Carboniferous limestone, probably of the Des Moines series. The Cretaceous is represented by several exposures of the Dakota sandstones and

conglomerates. Some of these conglomerates include silicified Niagara and Devonian fossils as part of the clastic materials. A few Cretaceous fossils have been identified. Undoubted chalk rock of the Niobrara, containing abundant *Inoceramus labiatus*, is exposed in one locality in association with the Dakota sandstone.

The Pleistocene deposits are considered in detail. A new development from the field investigation is the demonstration that much of the extra-Wisconsin drift, hitherto provisionally correlated with the Iowan, belongs to an anomalous phase of the Kansan, which shows many peculiarities, near the border of the Wisconsin, due either to some protecting influence during the period of post-Kansan erosion, or to some subsequent modification referable to the presence of the loess and the proximity of the Wisconsin drift. The loess is called Iowan in age and lies beneath the Wisconsin, except at some places where a thin mantle of it covers the edge of the latter, evidently as a recent wind deposit. The loess of this region is not of sufficient depth to have developed its own peculiar type of topography.

The coal prospect for Carroll county is an exceedingly uncertain problem and, in Dr. Bain's opinion, is to be solved only by the drill, and that only at large expense, chiefly because of the great depth of the drift. Moreover, the great distance from the known outcrops of coal make it possible that the productive measures may have thinned out altogether in Carroll county. The other mineral resources of the county are inconsiderable. The water supply is entirely sufficient. The area includes several artesian wells.

The report for Carroll county is fairly representative of the method and character of the work done in the other counties and only special details of the other papers demand consideration. Mr. T. H. McBride, in the report upon Humboldt county, identifies the Kinderhook and Saint Louis of the Mississippian series and the Des Moines of the Coal Measures. The latter is covered by the glacial series, of which the pre-Kansan, Aftonian, Kansan, Buchanan and Wisconsin are recognized.

The Wisconsin sheet is merely a thin veneer, conforming to the previously established Kansan-Buchanan topography. This is worthy of note in the light of other observations on the relations of recent drift sheets to underlying unindurated formations. The somewhat paradoxical inference is suggested that the ice sheet was normally less competent to disturb the surface of a deep formation of loose materials than the surface of an exposed indurated rock. A gravel formation,

as it was being overridden, became the basal part of the ice and exhausted to a degree its transporting capacity, forming the effective load of the natural stagnation zone at the base of the ice. Over a rock surface, on the other hand, the ice may have possessed its maximum of transporting and abrading power.

A unique detail in the drainage of Humboldt county is the practice, reported of draining kettle-hole lakes in certain districts by sinking wells through impervious layers to a porous stratum. The method appears to be effective and economical, though its sanitary bearing upon the drinking water of the region may be worthy of consideration.

A notable feature of Mr. Beyer's report on Story county, also of Professor Udden's on Muscatine county, is the determination of deformations. The gentle flexures, of which the Skunk River anticline is a type, are suggestive when considered with similar structures which have been reported at many points in the exposures of different formations across the upper Mississippi basin. The reiterated recognition of such structure suggests that the phenomena of crustal shortening have been restricted by no means to the mountain belts of the coastal regions but that these gentler flexures, affecting such immense areas, may have been, in the aggregate, an equally notable factor in the adjustment of the external masses of the earth to internal changes.

Mr. Beyer gives an excellent report on the stratigraphy, including many valuable well records. The discussion of the development of the Skunk River system is an instructive physiographic study. The course of the pre-Wisconsin channel, the transference of much of the Skunk River drainage area to the Des Moines system by the Wisconsin invasion, the post-glacial struggle of the stream toward readjustment, form the substance of a finely developed discussion. Remains of the Mammoth are reported by Mr. Beyer from an excavation four or five feet below the surface of the Wisconsin drift. Coal, clay and building stones are the economic products of Story county.

The report on Muscatine county by Professor Udden is characterized by carefully derived conclusions and is rendered thoroughly readable by the excellent style of presentation, and enjoyable by the variety of new and sharply observed phenomena. The stratigraphy of the county includes the Gower stage of the Niagara, Wapsipinicon and Cedar Valley stages of the Hamilton, Sweetland Creek beds of the Upper Devonian, Kinderhook group of the Mississippian and the Des Moines stage of the Coal Measures. This article contains an exhaustive discussion

of the drift with many close, but distinctly drawn, discriminations. The following Pleistocene formations are recognized : anteglacial silts, pre-Kansan, Aftonian, Kansan and Illinoian. The anteglacial silt is a new division. It is explained as having been formed by water and wind ahead of the invading pre-Kansan ice-sheet. If that be its origin, it might properly belong with the pre-Kansan drift and the division would appear unnecessary. If every aqueous deposit of the drift should receive a special name, the clarifying effects of analysis would soon be lost in confusion. The economic products of Muscatine county include coal, though in unprofitable amount, small quantities of gas, building stones and clay.

The geology of Scott county, by Professor W. H. Norton, contains much fresh information. The passages in the paper dealing with the history of the drainage and with the stratigraphy are of special value. Touching the former, this region is particularly interesting because of its location at the southern limits of the driftless area and the consequent complexity of the drift phenomena arising from the mutual interference of the ice lobes at this place.

The report on the artesian wells of the Belle Plaine area by H. R. Mosnat gives a thorough exposition of the geology of the water-bearing formation, the amount of the flow and the source of the water. The computations rising from the study of flow and supply develop many facts which simplify to a great degree the conception of the combination of conditions appropriate to the formation of artesian wells. A most significant passage is that discussing the rate of movement of the underground water through materials of different texture. It is estimated that nineteen years would be required for the water of the aquifer to move in a direct line from Vining to Ladora along the major axis of the artesian area. Hence, the writer concludes, the great exhaustion of the water body brought about at Vining by the remarkable flow of the great Jumbo well when it was opened, will not affect the flow at Ladora before the year 1905. He also shows the limited extent of surface actually necessary to supply the water for the aquifer and the adequacy of the rainfall to produce the supply without any recourse to the extravagant superstitions which have made this artesian area "the eighth wonder of the world" in the minds of the inhabitants of the region. The discussion is closed with a paragraph on the uses of the water, which largely relegates the wells to the category of interesting

geological phenomena whose practical and economic value is doubtful or, at any rate, decidedly limited.

This volume is carefully printed and amply illustrated by expressive and well selected photographs, sections and sketch maps.

J. W. FINCH.